

REMARKS/ARGUMENTS

Introduction:

Claim 43 is amended, and claims 108 and 109 are newly added. Claims 43, 48, 49, 51-57, 59-65, 74-81, and 93-109 are now pending in the application. (Claims 1-42, 44-47, 50, 58, 66-73, and 82-92 were previously canceled.) Applicants respectfully request reexamination and reconsideration of the application.

Applicants thank the Examiner for the courtesy extended to Applicants' representative at an in-person interview on April 26, 2007. As discussed below, Applicants have amended independent claim 43 to recite making scrub marks on the recited terminals as suggested by the Examiner. New claims 108 and 109 also recite scrub marks.

Rejection Under 112, Second Paragraph:

Claim 43 was rejected under 35 USC 112, second paragraph. Applicants have amended claim 43 to address the Examiner's concerns and believe that the rejection has been overcome.

Applicants do not, however, understand the need for the Examiner's comment that "ones" means "plurality." Applicants respectfully assert that the claims are clear as drafted and are understandable without such paraphrasing.

Rejection Under 35 USC 102:

Claims 43, 48, 49, 51-57, 59-65, 74-81, and 93-107 were rejected under 35 USC 102(b) as anticipated by US Patent No. 5,012,187 to Littlebury ("Littlebury"). Applicants respectfully traverse this rejection.

Claim 43 recites "adjusting a planar orientation of probe elements of a probe card assembly to correspond to a planar orientation of . . . electrical contact terminals" of semiconductor devices and "effecting contact between ones of said . . . contact terminals . . . and ones of said probe elements." Claim 43 describes "said contact [as] causing said ones of said probe elements to be pressed with a contact force against and to wipe across said . . . contact terminals . . . and thereby make scrub marks on said . . . contact terminals."

Initially, Applicants note that claim 43 is fully supported by non-limiting examples in the specification. For example, the specification discusses non-limiting examples of adjusting an orientation of probe elements to correspond to an orientation of terminals of a semiconductor

device to be tested (see, e.g., pg. 64, line 9 to pg. 68, line 17). The specification also includes non-limiting examples of probe elements and terminals of semiconductor devices being brought into contact (see, e.g., pg. 57, lines 10-13), and the specification discusses effecting the foregoing contact with sufficient force between the probes and terminals to establish sufficiently reliable electrical connections between the probes and the terminals to test the semiconductor devices. (See, e.g., pg. 5, lines 7-25; and pg. 32, lines 7-12.) The specification also states that the probe elements can be configured to scrub or wipe across the terminals to thereby cut through debris on the terminals, again to establish reliable electrical connections. (See, e.g., pg. 3, lines 5; pg. 14, lines 9-12; and pg. 23, lines 4-6.) A person of ordinary skill would readily understand that the combination of the contact forces between the probes and terminals and the wiping or scrubbing of the probes across the terminals will necessarily produce scrub marks on the terminals. For at least the foregoing reasons, claim 43 is fully supported by the specification.

Turning now to the rejection of claim 43 in view of Littlebury, as discussed in Applicant's previous Amendments dated December 18, 2006 and June 6, 2006, the process recited in claim 43 gives rise to structural differences in the resulting tested semiconductor device as compared to prior art semiconductor dies like Littlebury. Exhibit I attached hereto illustrates a depiction of non-limiting exemplary probe elements attached to an exemplary probe substrate. In Figure A of Exhibit I, the probe elements and the terminals of a semiconductor device are apart. In Figure B, the probe elements and/or the terminals are moved and brought into contact with each other. As shown in Figure C, the probe elements and/or the terminals can be moved past first contact so that the probe elements compress and exert forces against the terminals. Such a force can aide in creating electrical connections between the probe elements and the terminals. Typically, the probe elements create marks, which are often called scrub marks, on the terminals, and the size of each scrub mark is typically proportional to the force exerted by a probe element against the terminal.

Because of the "adjusting a planar orientation of probe elements of a probe card assembly to correspond to a planar orientation of said electrical contact terminals" recited in claim 43, the probe elements of claim 43 can be adjusted to be generally co-planar with respect to the terminals of the semiconductor device prior to effecting contact between the probe elements and the terminals. For this reason, the forces exerted by the probe elements against the terminals will be generally similar from probe to probe. Consequently, the scrub marks recited in claim 43

made by the probe elements will be generally uniform from terminal to terminal as depicted in a non-limiting, simplified example shown in Figure D. (Figure D shows a top view of the semiconductor device, which is shown in side view in Figures A-C.)

In contrast, a semiconductor device tested using a process that does not include "adjusting a planar orientation of probe elements of a probe card assembly to correspond to a planar orientation of said electrical contact terminals" will have irregular scrub marks from terminal to terminal. Figures E-G in Exhibit 2 (which is attached hereto) show probe elements that are out of planarity with terminals of a semiconductor device. As a result, the probe element on the left hand side in Figures E-G is the first probe element to contact a terminal, and the probe element on the right hand side is the last probe element to contact a terminal, as shown in Figure F. As shown in Figure G, as all of the probe elements are brought into contact with the terminals, the probe elements on the left hand side are compressed to a greater degree than the probe elements on the right hand side, which means each probe element exerts a different level of force against a terminal. As shown in Figure H (which shows a top view of the semiconductor device), the resulting pattern of scrub marks left on the terminals is not uniform. Rather, the probes that exerted larger forces leave larger scrub marks. The resulting pattern can be a pattern of increasingly larger scrub marks from the right-most terminal moving toward the left-most terminal.

Littlebury discloses no mechanism for adjusting an orientation of probes 17 to correspond to an orientation of the terminals 13 of chips 12A, 12B. Rather, Littlebury relies solely on the flexibility of membrane 16 to compensate for mis-orientation of probes 17 and terminals 13 as the probes 17 are brought into contact with the terminals 13. Thus, in Littlebury, ones of probes 17 will contact ones of terminals 13 at different times with effects similar to what is shown in attached Exhibit 2. Littlebury's dies will thus have less uniform, less regular scrub marks.

Thus, the tested semiconductor device of claim 43 is structurally different than a semiconductor device tested using a prior art process—e.g., the dies disclosed in Littlebury—that lacks the "adjusting a planar orientation of probe elements of a probe card assembly to correspond to a planar orientation of said electrical contact terminals" recited in claim 43. That is, the tested semiconductor device of claim 43 has a more uniform, regular pattern of scrub marks on its terminals; in contrast, a prior art semiconductor device—like the dies in Littlebury—will have a pattern of scrub marks on its terminals that is not uniform.

Moreover, uniform, regular scrub marks are more advantageous than irregular scrub marks. This is because scrub marks on terminals of a semiconductor device can cause several problems. First, scrub marks can prevent a wire from being bonded to a terminal. (The terminals of a semiconductor device are often connected to conductors of a protective package by wires.) Second, even if a wire is successfully bonded to a terminal with a scrub mark, the scrub mark can decrease the effective life of the bond between the wire and the terminal. Third, a scrub mark can weaken a terminal, causing the terminal to loosen or even detach from the semiconductor device. (See U.S. Patent No. 5,506,499 to Puar ("Puar"), col. 2, lines 21-40 and col. 3, lines 7-25 for a discussion of the detrimental effects of scrub marks.) Increasing the uniformity of the scrub marks across terminals of a semiconductor device can reduce the foregoing problems. For example, increasing the uniformity of the scrub marks typically prevents the formation of large scrub marks, which are particularly detrimental.

Indeed, the lack of uniformity in scrub marks left on a die by a probe card assembly that is not precisely planarized with the die is recognized in the industry as a problem, as evidenced by U.S. Patent No. 5,861,759 to Bialobrodski et al. ("Bialobrodski").¹ (See Bialobrodski col. 1, lines 14-23; col. 3, lines 23-33; and Figure 4.) That precisely planarizing the probes of the probe card assembly with the die produces a die that has generally uniform scrub marks and is therefore different and better than a prior art die tested with a probe card assembly that is not precisely planarized with the die is known in the industry is also evidenced by Bialobrodski. (See Bialobrodski col. 3, lines 34-44.)

Applicants assert that the foregoing differences between the tested semiconductor device produced by the method of independent claim 43 and Littlebury's dies render claim 43 patentable over Littlebury.

Claims 48, 49, 51-57, 59-65, 74-81, and 93-109 depend from claim 43 and are, at least because of this dependency, patentable over Littlebury. In addition, Applicants note that new dependent claims 108 and 109 recite additional features regarding the scrub marks not taught or suggested by Littlebury.

¹ Applicants note that Bialobrodski, which was not filed until January 29, 1997, is not prior art to the present application, which claims priority through a chain of continuation and divisional applications to U.S. Patent No. 5,974,662, which was filed on November 9, 1995.

Conclusion:

In view of the foregoing, Applicants submit that all of the claims are allowable and the application is in condition for allowance. If at any time the Examiner believes that a discussion with Applicants' attorney would be helpful, the Examiner is invited to contact the undersigned at (801) 426-2106.

Respectfully submitted,

Date: July 5, 2007

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